

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



528066

(43) International Publication Date  
29 April 2004 (29.04.2004)

PCT

(10) International Publication Number  
WO 2004/035142 A1

(51) International Patent Classification<sup>7</sup>: A62B 7/14,  
18/02, 18/08

(21) International Application Number:  
PCT/GB2003/004520

(22) International Filing Date: 20 October 2003 (20.10.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0224293.1 18 October 2002 (18.10.2002) GB  
0300365.4 8 January 2003 (08.01.2003) GB

(71) Applicant and

(72) Inventor: MCFARLANE, Robert [GB/GB]; 30  
Lochhead Avenue, The Cooperage, Lochwinnoch,  
Renfrewshire PA12 4AW (GB).

(74) Agent: KENNEDYS PATENT AGENCY LIMITED;  
Floor 5, Queens House, 29 St. Vincent Place, Glasgow G1  
2DT (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT (util-  
ity model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH,

CN, CO, CR, CU, CZ (utility model), DE (utility model),  
DK (utility model), DM, DZ, EC, EE (utility model), ES,  
FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,  
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,  
MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT,  
RO, RU, SC, SD, SE, SG, SK (utility model), SL, TJ, TM,  
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,  
ZW.

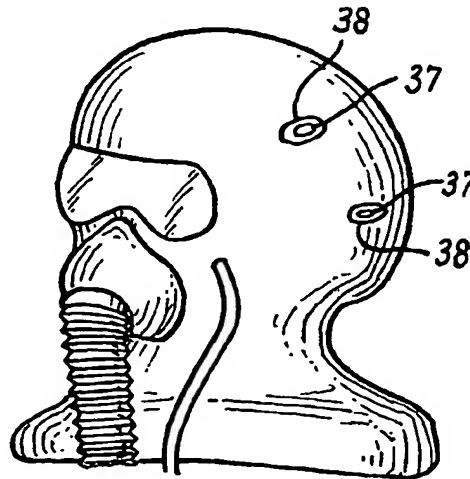
(84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments

For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: INTEGRATED RESPIRATOR



(57) Abstract: An integrated respirator and a method of producing the same is described. The integrated respirator comprises a rigid helmet and a flexible cowl having an airtight neck seal. When deployed by a user the integrated respirator provides a barrier for nuclear, biological and chemical hazards while maintaining a high level of comfort and user acceptability since it is designed to avoid direct contact of the flexible cowl with the user's head. The design of the described integrated respirator also provides it with a certain degree of inherent flexibility. This flexibility allows the integrated respirator to be adjusted so as to improve user comfort while also permitting the same design to be employed by different users.

1 **Integrated Respirator**

2

3 This invention relates to a respirator. In particular it  
4 relates to an integrated respirator that is suitable for  
5 use by aircrew so as to provide significant higher levels  
6 of comfort, stability and user acceptability.

7

8 Aircrew can be exposed to nuclear, biological and  
9 chemical (NBC) hazards in the course of their flying  
10 duties. Therefore, in order to negate the effects of  
11 such NBC hazards any respiratory system as well as the  
12 crews eyes must be protected against aerosols and gases  
13 in the air. Additionally, the rest of the body of any  
14 crew member must be protected against direct contact with  
15 NBC agents in the form of liquid or solid particles.

16

17 Protection of respiratory systems, eyes and skin area  
18 above the neck of aircrew is normally achieved by wearing  
19 an integrated respirator. Typical integrated respirator  
20 known to those skilled in the art consists of, but are  
21 not exclusively limited to, a head cowl or hood, an  
22 oxygen mask, a breathing gas supply hose, a clear visor,  
23 a neck seal and a shoulder cover that forms a leak-proof  
24 assembly that fully encloses the head.

1 Such respirators are specifically designed to either fit  
2 over or under the users flying helmet. Such designs have  
3 a number of inherent problematic features. In particular  
4 the over the helmet designs are bulky, and are easily  
5 ruptured in wind blast and ejection forces exhibited  
6 during emergency egress. Furthermore, it is difficult to  
7 interface the over the helmet designs with other  
8 equipment that requires to be mounted with the users  
9 flying helmet.

10

11 For these reasons the under helmet configuration has been  
12 adopted by most aircrew. There are two main types of  
13 under helmet respirator known in the art. The first type  
14 is worn under the helmet assembly and forms a close  
15 fitting hood around the head with an integral visor  
16 aperture and oxygen mask. This respirator type has  
17 several deficiencies the principal being that most users  
18 experience feelings of isolation or, semi-claustrophobia,  
19 and heat stress attributed to the hood hugging the head  
20 and being held firmly in place by the helmet.

21

22 A second limitation of this type of respirator is the  
23 associated reduced sound attenuation performance of the  
24 ear cup. This is due to the respirator cowl fitting  
25 between the ear and the ear cup.

26

27 A further deficiency of these respirators is the fact  
28 that the material used for the hood must stretch for  
29 donning and doffing. Thereafter, the material must  
30 conform to the profile of the user's head so as to  
31 provide a suitable mounting surface for the helmet.  
32 Bromo butyl rubber is an example of an elastic material  
33 used in the manufacture of cowls for such respirators.  
34 However, this material produces high levels of discomfort

1 when worn next to the skin while reducing the stability  
2 of the helmet.

3

4 Head mounted respirators with potentially lower levels of  
5 discomfort are also available. However, the materials  
6 used to construct such respirators do not stretch and as  
7 such the cowl shape is required to be manufactured from  
8 several shaped sections that are stitched and/or bonded  
9 together. As a result these respirator designs are  
10 particularly prone to leakage through the stitched and  
11 bonded seams.

12

13 Another type of under helmet respirator known to those  
14 skilled in the art employs comfort padding and  
15 communication system ear cups on the inside surface of  
16 the cowl. This arrangement allows air movement inside  
17 the cowl reducing the thermal stress. In addition, as  
18 the ear cups are in direct contact with the head this  
19 results in improved levels of sound attenuation. The  
20 major disadvantages of this type of respirator is the  
21 difficulty experienced in getting the ear cups correctly  
22 positioned inside the cowl and the requirement for an  
23 increased number of leak proof feed through apertures  
24 such as ear cup cableforms and comfort pad to suspension  
25 system fastenings. This results in unacceptable donning  
26 times and an increased potential for faults leading to  
27 leakage.

28

29 It is an object of an aspect of the present invention to  
30 provide an integrated respirator that provides a high  
31 level of comfort, helmet stability and user acceptability  
32 by being designed and constructed so as to reduce direct  
33 contact with a user's head so rendering the respirator  
34 easy for a user to don and doff.

1  
2 According to a first aspect of the present invention  
3 there is provided an integrated respirator that provides  
4 an airtight barrier for a user's head comprising a first  
5 rigid helmet and a flexible cowl having an airtight neck  
6 seal, wherein the first rigid helmet defines an access  
7 aperture suitable for locating directly on a user's head  
8 and the flexible cowl is sealably fixed to the first  
9 rigid helmet so providing a physical barrier for the  
10 access aperture while forming an airtight seal with a  
11 user's neck.

12  
13 Most preferably the first rigid helmet and the flexible  
14 cowl comprises material that protects against nuclear,  
15 chemical and biological hazards.

16  
17 Preferably the flexible cowl completely encloses the  
18 first rigid helmet. Alternatively, the flexible cowl is  
19 connected to the periphery of the access aperture. In a  
20 further alternative the flexible cowl connects to an  
21 inner surface of the first rigid helmet.

22  
23 Most preferably the first rigid helmet provides a tight  
24 fit with the user's head.

25  
26 Optionally the integrated respirator further comprises a  
27 hood that is fixed to the first rigid helmet so providing  
28 a physical barrier for the flexible cowl thus improving  
29 the fire proof, snag proof and windblast proof properties  
30 of the integrated respirator.

31  
32 Preferably the flexible cowl comprises a visor aperture,  
33 an oxygen mask location area, a visor mist air supply and  
34 a pressure release valve.

1

2 Preferably the integrated respirator further comprises a  
3 second rigid helmet suitable for locating over the first  
4 rigid helmet, an oxygen mask and a first visor.

5

6 Preferably the oxygen mask location area comprises a  
7 plurality of apertures suitable for receiving one or more  
8 component parts of the oxygen mask when the oxygen mask  
9 is located within the oxygen mask location area.  
10 Alternatively, the oxygen mask location area comprises a  
11 single aperture suitable for receiving the oxygen mask.

12

13 Most preferably the oxygen mask comprises a coating that  
14 provides a barrier for nuclear, biological and chemical  
15 hazards.

16

17 Most preferably the oxygen mask provides an air tight  
18 seal about the user's nose and mouth.

19

20 Optionally the flexible cowl further comprises a  
21 detachable front face connected to the flexible cowl by a  
22 first airtight seal.

23

24 Preferably the first airtight seal comprises a beading  
25 edge associated with the detachable front face, a channel  
26 associated with the flexible cowl and suitable for  
27 receiving the beading edge and a zip mechanism suitable  
28 for opening and sealing the first airtight seal.

29

30 Optionally the flexible cowl comprises attachment point  
31 access holes and compression seals.

32

33 Optionally the flexible cowl further comprises a head  
34 cowl and a detachable lower section wherein the head cowl

1 and detachable lower section are connected by a second  
2 airtight seal.

3

4 Preferably the second airtight seal comprises a beading  
5 edge associated with the head cowl, a channel associated  
6 with the detachable lower section and suitable for  
7 receiving the beading edge and a zip mechanism suitable  
8 for opening and sealing the second airtight seal.

9

10 Preferably the first rigid helmet further comprises an  
11 energy absorbing liner, attachment points suitable for  
12 threading through the attachment point access holes such  
13 that the first rigid helmet can be connected to the  
14 second rigid helmet.

15

16 Preferably the first rigid helmet further comprises ear  
17 phones and at least one earphone aperture associated with  
18 each earphone.

19

20 Preferably the first rigid helmet further comprises  
21 attachment means suitable for connecting oxygen mask  
22 mounting means of the oxygen mask to the first rigid  
23 helmet.

24

25 Optionally the first rigid helmet comprises a retractable  
26 earphone mount wherein the retractable earphone mount  
27 comprises a bias means that acts to maintain an  
28 associated earphone in a first position and a retracting  
29 means suitable for overcoming the bias means such that  
30 the associated earphone is moved to a second retracted  
31 position suitable for aiding the donning and doffing of  
32 the integrated respirator.

33

1 Preferably the retracting means comprises a draw string  
2 threaded through an aperture in the first rigid helmet.  
3 Optionally the first rigid helmet further comprises a  
4 securing means to which the draw string can be attached  
5 so as to maintain the retractable earphone mount in the  
6 second retracted position.

7

8 Most preferably the first visor locates within the first  
9 visor aperture so providing a visor airtight seal with  
10 the flexible cowl.

11

12 Optionally the visor airtight seal provides means for  
13 adjustment of the position of the first visor relative to  
14 the rigid helmet.

15

16 Preferably the means for adjustment allows the visor to  
17 move to a displaced position suitable for aiding the  
18 donning and doffing of the integrated respirator.

19

20 Optionally the second rigid helmet further comprises a  
21 second visor.

22

23 Preferably the first and second visors comprise a high  
24 optical quality material that provides a barrier for  
25 nuclear, biological and chemical hazards.

26

27 According to a second aspect of the present invention  
28 there is provided a method of fabricating an integrated  
29 respirator in accordance with the first aspect of the  
30 present invention comprising:

- 31 1) Fabricating a flexible cowl;  
32 2) Forming an oxygen mask location area and a  
33 visor aperture in the flexible cowl;



- 1           3)     Locating a visor within the visor aperture so  
2                as to form an airtight seal between the visor  
3                and the flexible cowl;  
4           4)     Locating an oxygen mask within the oxygen mask  
5                suspension system aperture so as to form an  
6                airtight seal between the oxygen mask and the  
7                flexible cowl; and  
8           5)     Attaching the flexible cowl to a first rigid  
9                helmet so as to form an airtight seal between  
10               the first rigid helmet and the flexible cowl.

11  
12   Preferably location points on the helmet ensure that the  
13   flexible cowl is correctly located on the first rigid  
14   helmet and provide means for connecting the first rigid  
15   helmet to a second rigid helmet.

16  
17   Most preferably the flexible cowl is fabricated by:

- 18           1) Vacuum forming a flexible material and fixing the  
19               vacuum formed material by seam welding;  
20           2) Fabricating an airtight neck seal and attaching  
21               said neck seal to the vacuum formed material;

22  
23   preferably the step of fabricating the flexible cowl  
24   further comprises the steps of:

- 25           1) Connecting a visor mist air supply to the vacuum  
26               formed material; and  
27           2) Connecting a pressure release valve to the vacuum  
28               formed material.

29  
30   Preferably the visor is injection moulded from a material  
31   of high optical coating. Thereafter the outer surface of  
32   the visor is coated with a nuclear, biological and  
33   chemical resistant coating. Optionally the inner surface  
34   of the visor is coated with an anti fogging coating.

1  
2 Embodiments of the invention will now be described, by  
3 way of example only, with reference to the accompanying  
4 drawings, in which:

5

6 Figure 1 present a schematic representation of an  
7 integrated respirator in the absence of an  
8 outer helmet in accordance with an aspect of  
9 the present invention;

10 Figure 2 present a schematic representation of the outer  
11 helmet suitable for use with the integrated  
12 respirator of Figure 1;

13 Figure 3 presents detail of an inner helmet of the  
14 integrated respirator of Figure 1;

15 Figure 4 presents detail of an oxygen mask of the  
16 integrated respirator of Figure 1;

17 Figure 5 presents detail of a flexible cowl of the  
18 integrated respirator of Figure 1;

19 Figure 6 presents detail of a connection means for a  
20 visor and the flexible cowl of Figure 5:

21 (a) when the visor is positioned over a user's  
22 eyes; and

23 (b) when the visor is in a displaced position  
24 suitable for donning and doffing the  
25 integrated respirator;

26 Figure 7 presents detail of an alternative embodiment  
27 connection means for the visor and the flexible  
28 cowl of Figure 5;

29 Figure 8 illustrates the formation of the integrated  
30 respirator by employing a vacuum forming  
31 method;

32 Figure 9 presents an alternative embodiment of the  
33 integrated respirator in accordance with  
34 aspects of the present invention;

1 Figure 10 presents detail of an attachment means of the  
2 integrated respirator of Figure 9;

3 Figure 11 presents a further alternative embodiment of  
4 the integrated respirator in accordance with  
5 aspects of the present invention; and

6 Figure 12 presents a yet further alternative embodiment  
7 of the integrated respirator in accordance with  
8 aspects of the present invention;

9 Figure 13 presents detail of a connection means for an  
10 earphone and a flexible cowl of the integrated  
11 respirators of Figure 11 and 12:

12 (a) when the earphone is positioned over a  
13 user's ear; and

14 (b) when the earphone is in a displaced  
15 position suitable for donning and doffing  
16 the integrated respirator.

17 Figure 14 presents an alternative embodiment for the  
18 incorporation of the oxygen mask and the  
19 flexible cowl.

20

21 Figure 1 presents an integrated respirator 1 in  
22 accordance with an aspect of the present invention. The  
23 integrated respirator 1 can be seen to comprise an inner  
24 helmet 2, an oxygen mask suspension system 3, a visor  
25 demist air supply 4, a flexible cowl 5 on which is  
26 mounted a first visor 6 and a non-return exhaust valve 7.

27

28 The first visor 6 shown in Figure 1 is manufactured from  
29 a high optical quality material and is bonded or welded  
30 to the flexible cowl 5. NBC hazards when deposited on  
31 the visor would attack the surface of conventional  
32 polycarbonate visors therefore, to protect the visor a  
33 NBC resistant coating is applied to the outer surface.

1 The inner surface is also be coated with an anti fogging  
2 coating.

3

4 The visor demist air supply 4 also helps to prevent the  
5 misting of the visor by supplying a flow of air that is  
6 directed over the visor. The air, in normal mode, is  
7 exhausted from the flexible cowl 5 through the non-return  
8 exhaust valve 7 such that a positive pressure is  
9 maintained within the cowl.

10

11 Figure 2 presents an outer helmet 8 suitable for use with  
12 the integrated respirator 1. The outer helmet 8  
13 comprises an outer shell 9 on which are located outer to  
14 inner helmet attachment points 10 and a detachable second  
15 visor 11.

16

17 Details of the inner helmet 2, the oxygen mask 3 and the  
18 flexible cowl 5 are presented in Figures 3, 4 and 5  
19 respectively. The inner helmet 2 comprises an NBC  
20 resistant shell 12 with attachment points 13 for both the  
21 outer helmet 8 and oxygen mask suspension system 3. The  
22 inner helmet 2 is lined with impact absorbing liners 14  
23 and earphones 15 and earphone cabling 16 are attached to  
24 the inner surface.

25

26 The oxygen mask suspension system 3, shown in Figure 4  
27 comprises a face seal 17 that acts to isolate the mask  
28 oro-nasal breathing cavity from the flexible cowl 5 and  
29 the first visor 6. Therefore, the face seal 17 helps  
30 prevent misting of the first visor 6 by exhaled gases  
31 from the user. Breathing gas is supplied to the user by  
32 inhalation through a non-return inspiratory valve 18. On  
33 being exhaled the gas exits the oxygen mask suspension  
34 system 3 through a first non-return expiratory valve 19.

1 To prevent any reverse gas flow into the oxygen mask  
2 suspension system 3 a second non-return valve 20 is  
3 fitted in series with the first 19 so as to create an  
4 isolating chamber 21.

5

6 An examination of Figure 4 shows that the oxygen mask  
7 suspension system 3 further comprises two mask mounting  
8 means 22, two mask retention assemblies 23 and a gas  
9 supply hose 24. The combination of the mask mounting  
10 means 22 and the mask retention assemblies 23 allow the  
11 oxygen mask suspension system 3 to be directly connected  
12 to the inner helmet therefore helping to maintain the air  
13 tight seal between the face seal 17 and the flexible cowl  
14 5.

15

16 The gas supply hose 24 comprises a flexible pipe that is  
17 resistant to penetration by NBC contaminants. The hose  
18 24 is connected at one end to the face seal 17 while the  
19 other end is coupled to a supply of filtered air or  
20 oxygen from an aircraft oxygen generator. The gas supply  
21 hose 24 can also be coupled to a portable air supply for  
22 transit to and from an aircraft.

23

24 The flexible cowl 5 shown in Figure 5 specifically covers  
25 the portion of the head and neck of the user that is not  
26 protected by the inner helmet 2 and any NBC clothing worn  
27 by the user. A neck seal 25 provides the required  
28 airtight seal between the flexible cowl and the user's  
29 neck.

30

31 The oxygen mask suspension system 3 and the first visor 6  
32 are attached to the flexible cowl 5 and sealed to form a  
33 leak proof assembly. The non-return exhaust valve 7 acts  
34 as a pressure relief valve to prevent over pressurisation

1 within the flexible cowl 5. The non-return exhaust valve  
2 7 itself comprises non-return valves in series so as to  
3 prevent any reverse flow of gases back into the flexible  
4 cowl 5.

5

6 When the integrated respirator 1 is correctly mounted on  
7 the head, the oxygen mask suspension system 3 determines  
8 the viewing aperture located between the oxygen mask 3  
9 and the brow of the inner helmet 2. This viewing  
10 aperture, and in particular the vertical distance, varies  
11 from subject to subject. Therefore, to accommodate these  
12 variations, with a minimum number of visor sizes, an  
13 adjustable means 26 of fitting the first visor 6 to the  
14 flexible cowl has been developed.

15

16 Figure 6(a) presents detail of the adjustable means 26  
17 that is characterised in that it is larger in the  
18 vertical dimension, than the viewing aperture provided.  
19 A space under the brow of the inner helmet 2 is produced  
20 by foreshortening the energy absorbing liner 14.  
21 Therefore, when the first visor 6 is too large for the  
22 aperture the top of the first visor 6 is inserted into  
23 the space underneath the inner helmet 2 as shown. The  
24 upper area of the flexible cowl 5 has sufficient material  
25 to allow the first visor 6 to move into the space  
26 underneath the inner helmet 2. Similarly sufficient  
27 material is provided between the oxygen mask suspension  
28 system and the first visor 6 so as to set the distance  
29 between the eyes and the inner surface of the first visor  
30 6. To hold the first visor 6 in the optimum position it  
31 can be attached directly to the inner helmet 2 by, for  
32 example, draw strings or retaining clips that engage with  
33 receivers on the helmet.

34

1 A further advantage of incorporating the visor adjustment  
2 means 26 within the integrated respirator 1 can be seen  
3 in Figure 6(b). When donning the integrated respirator 1  
4 the excess material of the flexible cowl 5 around the  
5 first visor 6 and the oxygen mask suspension system 3  
6 permits both of these elements to be displaced to a  
7 position suitable for aiding the donning and doffing of  
8 the integrated respirator 1.

9

10 An alternative adjustment means 27 that also provides a  
11 method of accommodating the variations in vertical height  
12 between the oxygen mask suspension system 3 and the inner  
13 helmet 2 is shown in Figure 7. In this case, the  
14 flexible cowl material that attaches the first visor 6 to  
15 the brow and side apertures of the inner helmet 2, allows  
16 for fore and aft adjustment. As such the lower portion  
17 of the first visor 6 can sit over the oxygen mask  
18 suspension system 3.

19

20 To assemble the integrated respirator 1, the flexible  
21 cowl 5, with integral visor 6 and oxygen mask suspension  
22 system 3, is pulled over the inner helmet 2. Location  
23 points can be provided on the inner helmet 2 to ensure  
24 that the flexible cowl 5 is correctly positioned. This  
25 ensures the respirator components, such as the visor 6  
26 and oxygen mask suspension system 3, are correctly  
27 positioned. The overlap area between the inner helmet 2  
28 and the flexible cowl 5 is bonded to ensure a leak tight  
29 seal preventing any ingress of agents when there is a  
30 negative pressure inside the visor 6 or inner helmet 2.

31

32 The flexible cowl 5 and inner helmet 2 assembly when  
33 donned, is not in contact with the user's head but  
34 contacts the user at the neck seal 25 area. This

1 configuration prevents unacceptable levels of discomfort  
2 when wearing the NBC head protection.

3

4 By employing the aforementioned adjustment means, 26 or  
5 27, provides that one particular flexible cowl 5 can be  
6 used in conjunction with a number of inner helmets 2 of  
7 varying dimensions. This factor increases the  
8 compatibility of employing the same design of integrated  
9 respirator 1 with different users while allowing minor  
10 adjustments to increase user comfort.

11

12 Additional protection for the flexible cowl from  
13 penetration by debris during and after ejection from an  
14 aircraft may also be achieved by incorporating a hood  
15 (not shown) that is attached to the lower edge of the  
16 inner helmet so as to envelope the flexible cowl. Such a  
17 hood provides further fire proof, snag proof and  
18 windblast proof properties to the integrated respirator.

19

20 One method of fabricating the integrated respirator 1 is  
21 to vacuum form the developed shape of the flexible cowl 5  
22 from a sheet of NBC resistant flexible material as shown  
23 in Figure 8. The flexible cowl 5 is formed by seam  
24 welding to produce a leak-tight joint 28. Thereafter,  
25 the oxygen mask suspension system 29 and visor apertures  
26 30 are cut out of the flexible cowl.

27

28 The visor 6 is then injection moulded, for example from  
29 polycarbonate to a high optical quality and coated with a  
30 NBC resistant coating on the outside surface and with an  
31 anti fogging coating, if required, on the inside.  
32 Bonding areas of the visor 6 and the flexible cowl 5 are  
33 then prepared and the visor coating can, if required, be  
34 stripped off to provide a suitable bonding surface. The



1 visor 6 can then be bonded to the flexible cowl 5 using a  
2 suitable adhesive.

3

4 In a similar manner the oxygen mask suspension assembly 3  
5 is located within the appropriate aperture 29 and bonded  
6 with the flexible cowl 5 so as to produce the required  
7 leak tight seal. This may be achieved by the flexible  
8 cowl 5 being either fitted over or under the oxygen mask  
9 suspension assembly 3.

10

11 The neck seal 25 is also formed from a flexible NBC  
12 resistant material and bonded to the flexible cowl 5 to  
13 provide the required leak-tight seal at the neck area of  
14 the user.

15

16 An alternative embodiment of the integrated respirator 1  
17 is shown in Figure 9. In this embodiment the flexible  
18 cowl 5 comprises a detachable front section 31. Located  
19 on the front section 31 are the first visor 6 and the  
20 oxygen mask suspension system 3. Therefore, the  
21 detachable front section 31 allows for the removal of the  
22 first visor 6 and oxygen mask suspension assembly 3 if  
23 access is required in, for example, an emergency where  
24 the inspiratory 18 or expiratory valves 19 and 20 have  
25 jammed or the demist air supply 4 has failed.

26

27 The detachable front section 31 is attached and detached  
28 by means of an airtight seal 32, detail of which are  
29 provided in Figure 10. The airtight seal 32 comprises a  
30 beaded edge 33 formed on the front section 31 and a  
31 channel 34 that matches the shape of the beading 33,  
32 formed on the flexible cowl 5. A zip 35 operating in zip  
33 guides 36 formed in the flexible cowl 5 and the front  
34 section 31 pull the front section beaded edge 33 into the

1 channel 34 in the flexible cowl 5 thus forming a leak.  
2 proof seal, as required.

3

4 A further alternative embodiment of the integrated  
5 respirator is shown in Figure 11. Here the flexible cowl  
6 5 is formed by vacuum forming and fabricating a hood from  
7 a material that will stretch sufficiently to allow the  
8 neck seal 25 to pass over the inner helmet 2. The oxygen  
9 mask suspension system 3 and the first visor 6 are then  
10 fitted as described above.

11

12 Access to the inner to outer helmet fixing points 13 is  
13 achieved by means of apertures 37 provided in the  
14 flexible cowl 5. Sealing of the flexible cowl 5 to the  
15 inner helmet 2 can be achieved by means of compression  
16 seals 38. The compression seals 38, attached to the  
17 flexible cowl 5, are compressed against the inner helmet  
18 2 when the outer helmet 8 is placed on the user's head by  
19 the presence of the outer to inner helmet attachment  
20 points 10.

21

22 A yet further alternative embodiment of the integrated  
23 respirator is shown in Figure 12. In this particular  
24 embodiment the flexible cowl 5 consists of two parts.  
25 The first part comprises a head cowl 39 that fits over  
26 the inner helmet 2 while the second comprises a  
27 detachable lower portion 40 that protects the neck and  
28 shoulder area. The lower portion 40 can be formed from a  
29 flexible material that provides increased mobility for  
30 the user. The two parts are held together by a leak  
31 proof joint 41 that is similar to that described in  
32 Figure 10. The head cowl 39 can be manufactured to  
33 conform to the shape of the inner helmet 2. As the lower  
34 portion contains the neck seal 25, this is the only

1 component that is required to stretch over the head  
2 during fitting.

3

4 The integrated respirators shown in Figures 11 and 12 may  
5 be further adapted, so as to incorporate retractable  
6 earphones 42 as presented in Figure 13. Each earphone 15  
7 is mounted on the flexible respirator by means of  
8 Velcro ®. A leaf spring 43 mounted on the inner surface  
9 of the inner helmet 2, biases the earphone 15 (or foam  
10 padding) in a first position as shown in Figure 13(a).  
11 When a user pulls on a draw string 44, attached to the  
12 leaf spring 43, the bias force is overcome and the  
13 earphone 15 (or foam padding) is moved to a second,  
14 retracted position, as shown in Figure 13(b). The  
15 earphone 15 can be fixed in the retracted position by  
16 securing the draw string to an attachment means (not  
17 shown). The attachment means can be in the form of  
18 Velcro ®, a stud fastener, a hook or any other suitable  
19 means. On releasing the draw string 44 from the  
20 attachment means the bias force of the leaf spring 43  
21 acts to return the earphone 15 back to the first  
22 position. A compressible foam liner (not shown) may also  
23 be located between the leaf spring 43 and the inner  
24 helmet 2 so as to aid in the positioning of the earphone  
25 15.

26

27 The retractable earphones 42 provide a means for allowing  
28 the earphones 15 to be easily displaced thus aiding the  
29 donning and doffing of the integrated respirator. This  
30 is particularly advantageous for user's who require the  
31 use of spectacles as the retractable earphones 42 allow  
32 the integrated respirator to be employed without  
33 dislodging the spectacles from the user.

34

1 In a further embodiment, shown in Figure 14, an  
2 alternative design for the incorporation of the oxygen  
3 mask 3 and the flexible cowl 5 is presented. In this  
4 embodiment the flexible cowl 5 generally envelopes the  
5 oxygen mask 3. The required sealing of the oxygen mask  
6 is achieved by clamping the various components of the  
7 oxygen mask to the face seal 17 via a number of apertures  
8 created in the flexible cowl 5 e.g. an inspiratory valve  
9 aperture 45, an expiratory valve 46 aperture, a  
10 communication cables aperture 47 and a drinking tube 48  
11 aperture. The number of apertures created in the  
12 flexible cowl will obviously be dependent on the  
13 particular design of the oxygen mask to be employed.

14

15 The integrated respirator described in aspects of the  
16 present invention exhibits several key advantages over  
17 those described in the Prior Art.

18

19 When deployed by a user the integrated respirator  
20 provides a significantly high level of comfort and user  
21 acceptability since it is designed to avoid direct  
22 contact with the user's head. The integrated respirators  
23 thereby provide space for head cooling while  
24 simultaneously help to eliminate the feeling of  
25 claustrophobia and stress that are known to result from  
26 respirator hoods that fit closely over the wearer's head.  
27 Further embodiments of the present invention incorporate  
28 an adjustable visor and retractable earphones both being  
29 features that aid in the donning and doffing of the  
30 respirator.

31

32 The integrated respirator designs describe above  
33 incorporate a certain degree of inherent flexibility.  
34 This flexibility allows the integrated respirators to be

1 adjusted so as to improve user comfort while also  
2 permitting the same design to be employed by different  
3 users. In addition the present design reduces any  
4 alignment problems experienced by designs discussed in  
5 the Prior Art.

6  
7 A further advantage of the integrated respirators  
8 described herein is that they can be simply manufactured.  
9 This manufacturing process is flexible and so enables the  
10 use of the most appropriate materials for NBC protection,  
11 user acceptability and ease of manufacture.

12  
13 The foregoing description of the invention has been  
14 presented for purposes of illustration and description  
15 and is not intended to be exhaustive or to limit the  
16 invention to the precise form disclosed. The described  
17 embodiments were chosen and described in order to best  
18 explain the principles of the invention and its practical  
19 application to thereby enable others skilled in the art  
20 to best utilise the invention in various embodiments and  
21 with various modifications as are suited to the  
22 particular use contemplated. Therefore, further  
23 modifications or improvements may be incorporated without  
24 departing from the scope of the invention herein  
25 intended.

1   **Claims**

2

3   1) An integrated respirator that provides an airtight  
4       barrier for a user's head comprising a first rigid  
5       helmet and a flexible cowl having an airtight neck  
6       seal, wherein the first rigid helmet defines an  
7       access aperture suitable for locating directly on a  
8       user's head and the flexible cowl is sealably fixed  
9       to the first rigid helmet so providing a physical  
10      barrier for the access aperture while forming an  
11      airtight seal with a user's neck.

12

13   2) An integrated respirator as claimed in Claim 1  
14       wherein the first rigid helmet and the flexible cowl  
15       comprise a material that protects against nuclear,  
16       chemical and biological hazards.

17

18   3) An integrated respirator as claimed in Claim 1 or  
19       Claim 2 wherein the flexible cowl completely encloses  
20       the first rigid helmet.

21

22   4) An integrated respirator as claimed in Claim 1 or  
23       Claim 2 wherein the flexible cowl is connected to the  
24       periphery of the access aperture.

25

26   5) An integrated respirator as claimed in Claim 1 or  
27       Claim 2 wherein the flexible cowl connects to an  
28       inner surface of the first rigid helmet.

29

30   6) An integrated respirator as claimed in any of the  
31       preceding claims wherein the first rigid helmet  
32       provides a tight fit with the user's head.

33

1 7) An integrated respirator as claimed in any of the  
2 preceding claims wherein the integrated respirator  
3 further comprises a hood that is fixed to the first  
4 rigid helmet so providing a physical barrier for the  
5 flexible cowl thus improving the fire proof, snag  
6 proof and windblast proof properties of the  
7 integrated respirator.

8

9 8) An integrated respirator as claimed in any of the  
10 preceding claims wherein the flexible cowl comprises  
11 a visor aperture, an oxygen mask location area, a  
12 visor mist air supply and a pressure release valve.

13

14 9) An integrated respirator as claimed in any of the  
15 preceding claims wherein the integrated respirator  
16 further comprises a second rigid helmet suitable for  
17 locating over the first rigid helmet.

18

19 10) An integrated respirator as claimed in any of the  
20 preceding claims wherein the integrated respirator  
21 further comprises an oxygen mask and a first visor.

22

23 11) An integrated respirator as claimed Claim 8 wherein  
24 the oxygen mask location area comprises a plurality  
25 of apertures suitable for receiving one or more  
26 component parts of the oxygen mask when the oxygen  
27 mask is located within the oxygen mask location area.

28

29 12) An integrated respirator as claimed Claim 8 wherein  
30 the oxygen mask location area comprises a single  
31 aperture suitable for receiving the oxygen mask.

32

33 13) An integrated respirator as claimed Claim 10 to Claim  
34 13 wherein the oxygen mask comprises a coating that

1 provides a barrier for nuclear, biological and  
2 chemical hazards.

3

4 14) An integrated respirator as claimed Claim 10 to Claim  
5 13 the oxygen mask provides an air tight seal about  
6 the user's nose and mouth.

7

8 15) An integrated respirator as claimed in any of the  
9 preceding claims wherein the flexible cowl further  
10 comprises a detachable front face connected to the  
11 flexible cowl by a first airtight seal.

12

13 16) An integrated respirator as claimed in Claim 15  
14 wherein the first airtight seal comprises a beading  
15 edge associated with the detachable front face, a  
16 channel associated with the flexible cowl and  
17 suitable for receiving the beading edge and a zip  
18 mechanism suitable for opening and sealing the first  
19 airtight seal.

20

21 17) An integrated respirator as claimed in any of the  
22 preceding claims wherein the flexible cowl comprises  
23 attachment point access holes and compression seals.

24

25 18) An integrated respirator as claimed in any of the  
26 preceding claims wherein the flexible cowl further  
27 comprises a head cowl and a detachable lower section  
28 the head cowl and detachable lower section being  
29 connected by a second airtight seal.

30

31 19) An integrated respirator as claimed in Claim 17  
32 wherein the second airtight seal comprises a beading  
33 edge associated with the head cowl, a channel  
34 associated with the detachable lower section and



1       suitable for receiving the beading edge and a zip  
2       mechanism suitable for opening and sealing the second  
3       airtight seal.

4

5   20) An integrated respirator as claimed in Claim 17 to  
6       Claim 19 wherein the first rigid helmet further  
7       comprises an energy absorbing liner, attachment  
8       points suitable for threading through the attachment  
9       point access holes such that the first rigid helmet  
10      can be connected to the second rigid helmet.

11

12   21) An integrated respirator as claimed in any of the  
13       preceding claims wherein the first rigid helmet  
14       further comprises ear phones and at least one  
15       earphone aperture associated with each earphone.

16

17   22) An integrated respirator as claimed in Claim 10 to  
18       Claim 21 wherein the first rigid helmet further  
19       comprises attachment means suitable for connecting  
20       oxygen mask mounting means of the oxygen mask to the  
21       first rigid helmet.

22

23   23) An integrated respirator as claimed in Claim 21 or  
24       Claim 22 wherein the first rigid helmet comprises a  
25       retractable earphone mount wherein the retractable  
26       earphone mount comprises a bias means that acts to  
27       maintain an associated earphone in a first position  
28       and a retracting means suitable for overcoming the  
29       bias means such that the associated earphone is moved  
30       to a second retracted position suitable for aiding  
31       the donning and doffing of the integrated respirator.

32

33   24) An integrated respirator as claimed in Claim 23  
34       wherein the retracting means comprises a draw string

1 threaded through an aperture in the first rigid  
2 helmet.

3

4 25) An integrated respirator as claimed in Claim 24  
5 wherein the first rigid helmet further comprises a  
6 securing means to which the draw string can be  
7 attached so as to maintain the retractable earphone  
8 mount in the second retracted position.

9

10 26) An integrated respirator as claimed in Claim 10 to  
11 Claim 22 wherein the first visor locates within the  
12 first visor aperture so providing a visor airtight  
13 seal with the flexible cowl.

14

15 27) An integrated respirator as claimed in Claim 26  
16 wherein the visor airtight seal provides means for  
17 adjusting the position of the first visor relative to  
18 the first rigid helmet.

19

20 28) An integrated respirator as claimed in Claim 27  
21 wherein the means for adjustment allows the visor to  
22 move to a displaced position suitable for aiding the  
23 donning and doffing of the integrated respirator.

24

25 29) An integrated respirator as claimed in Claim 9 to  
26 Claim 28 wherein the second rigid helmet further  
27 comprises a second visor.

28

29 30) An integrated respirator as claimed in Claim 29  
30 wherein the first and second visors comprise a high  
31 optical quality material that provides a barrier for  
32 nuclear, biological and chemical hazards.

33

1 31) A method of fabricating an integrated respirator  
2 comprising the steps of:

- 3 1) Fabricating a flexible cowl;
- 4 2) Forming an oxygen mask location area and a  
5 visor aperture in the flexible cowl;
- 6 3) Locating a visor within the visor aperture so  
7 as to form an airtight seal between the visor  
8 and the flexible cowl;
- 9 4) Locating an oxygen mask within the oxygen  
10 mask suspension system aperture so as to form  
11 an airtight seal between the oxygen mask and  
12 the flexible cowl; and
- 13 5) Attaching the flexible cowl to a first rigid  
14 helmet so as to form an airtight seal between  
15 the first rigid helmet and the flexible cowl.

16  
17 32) A method of fabricating an integrated respirator as  
18 claimed in Claim 31 wherein location points on the  
19 helmet ensure that the flexible cowl is correctly  
20 located on the first rigid helmet and provide means  
21 for connecting the first rigid helmet to a second  
22 rigid helmet.

23  
24 33) A method of fabricating an integrated respirator as  
25 claimed in Claim 31 or Claim 32 wherein the step of  
26 fabricating the flexible cowl further comprises the  
27 steps of:

- 28 1) Vacuum forming a flexible material and fixing  
29 the vacuum formed material by seam welding; and
- 30 2) Fabricating an airtight neck seal and attaching  
31 said neck seal to the vacuum formed material;

32

1 34) A method of fabricating an integrated respirator as  
2 claimed in Claim 33 wherein the step of fabricating  
3 the flexible cowl further comprises the steps of:

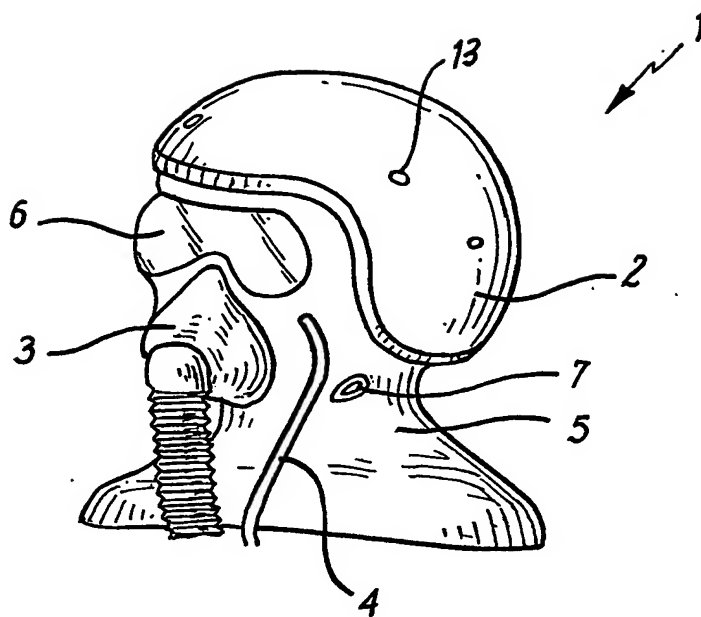
4 1) Connecting a visor mist air supply to the vacuum  
5 formed material; and

6 2) Connecting a pressure release valve to the vacuum  
7 formed material.  
8

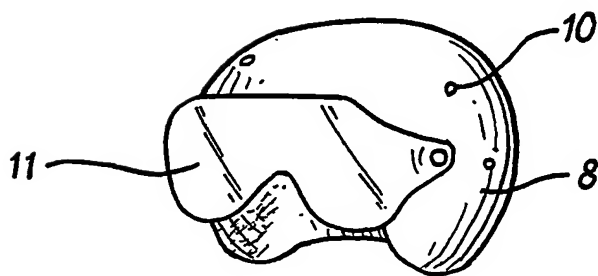
9 35) A method of fabricating an integrated respirator as  
10 claimed in Claim 31 to Claim 34 wherein the step of  
11 locating the visor further comprises the step of  
12 injection moulding the visor from a material of high  
13 optical coating.  
14

15 36) A method of fabricating an integrated respirator as  
16 claimed in Claim 31 to Claim 35 wherein the step of  
17 locating the visor further comprises the step of  
18 coating the outer surface of the visor with a  
19 nuclear, biological and chemical resistant coating.  
20

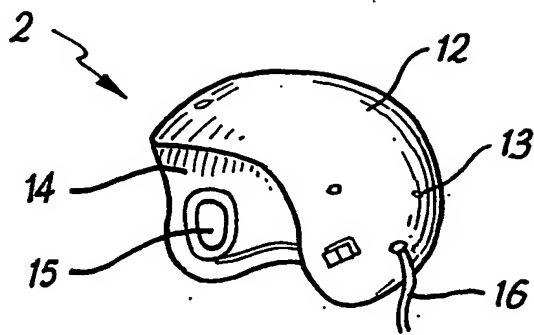
21 37) A method of fabricating an integrated respirator as  
22 claimed in Claim 31 to Claim 36 wherein the step of  
23 locating the visor further comprises the steps of  
24 coating the inner surface of the visor with an anti  
25 fogging coating.



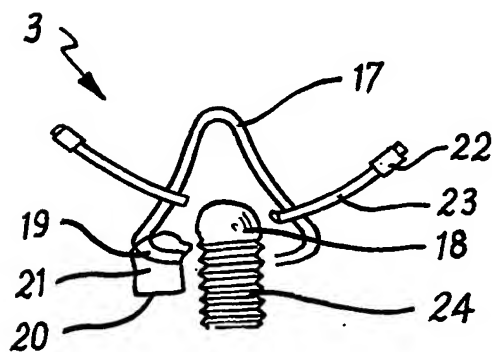
**FIG. 1**



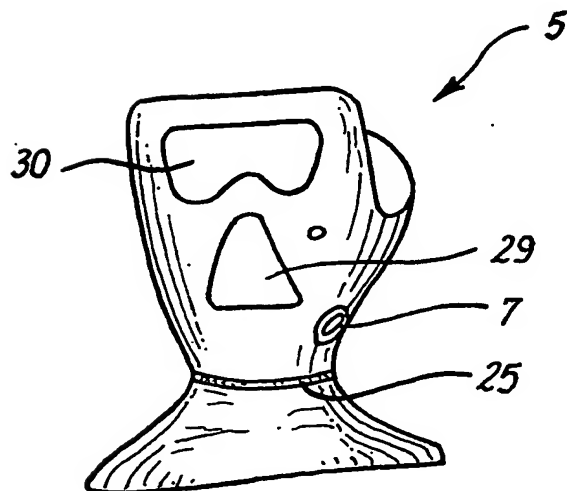
**FIG. 2**



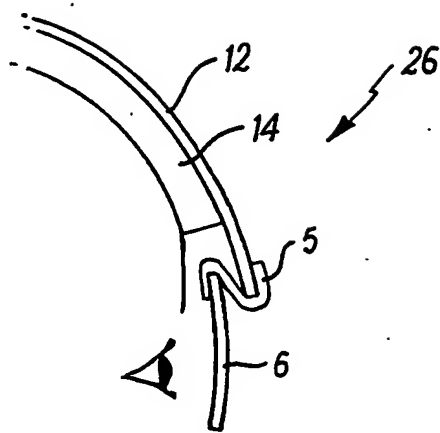
**Fig. 3**



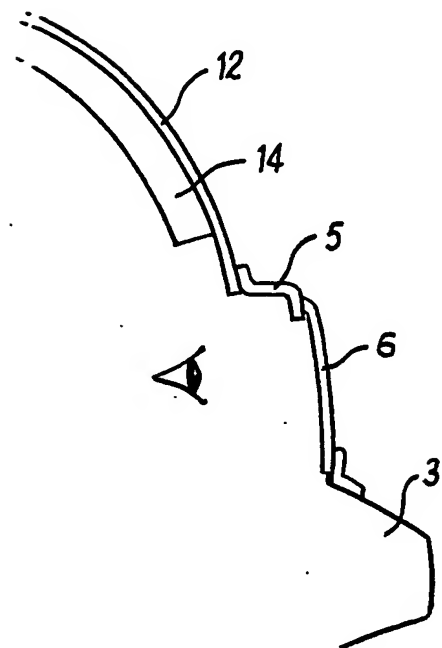
**Fig. 4**



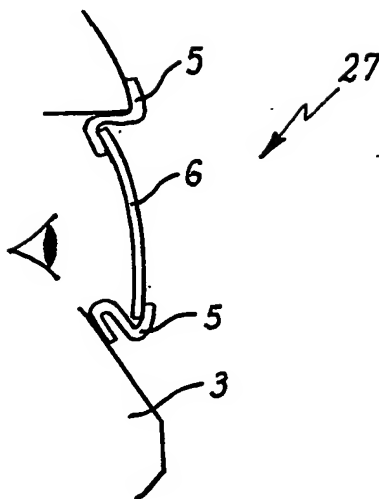
**Fig. 5**



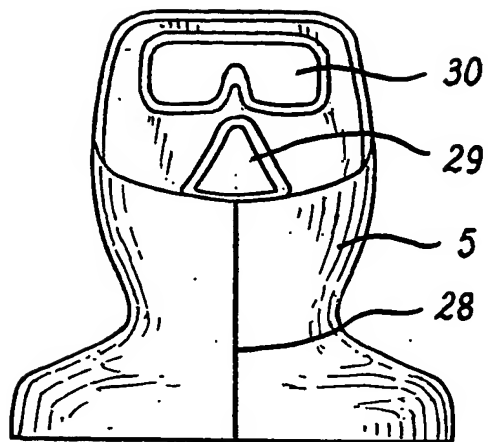
**Fig. 6(a)**



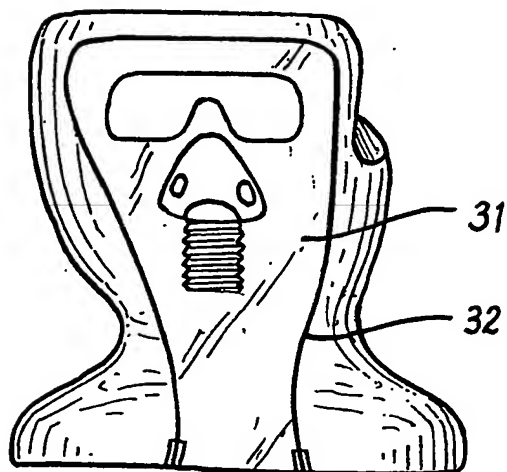
**Fig. 6(b)**



**Fig. 7**

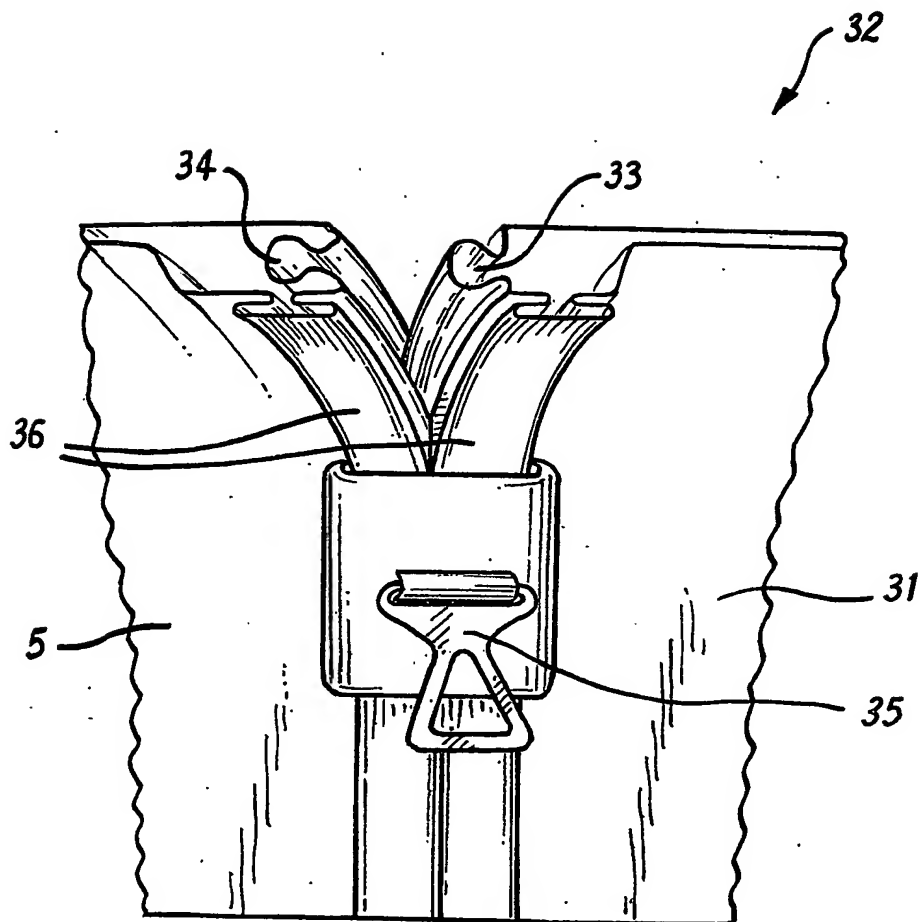


**FIG. 8**

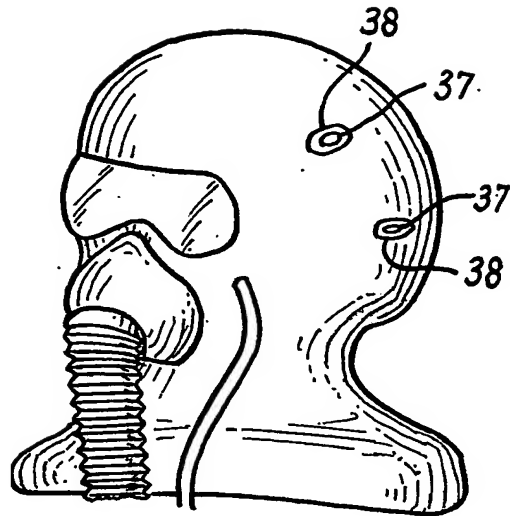


**FIG. 9**

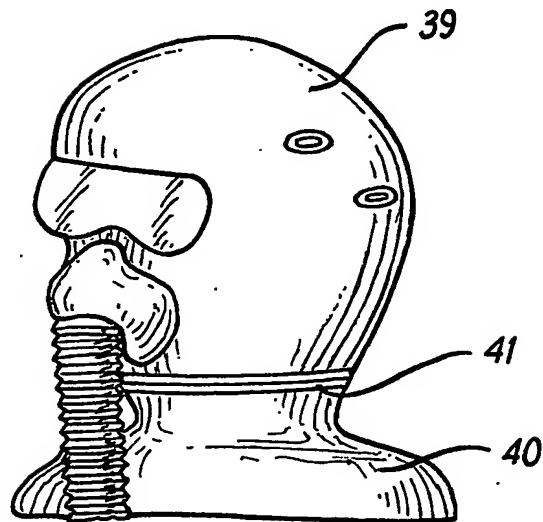




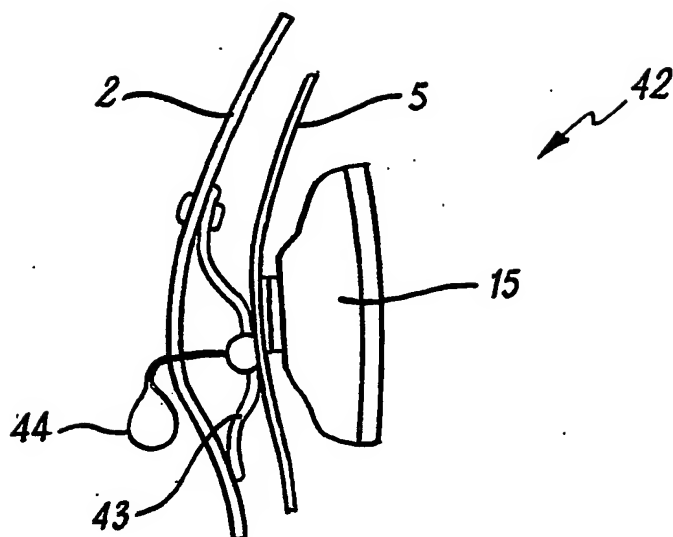
**Fig. 10**



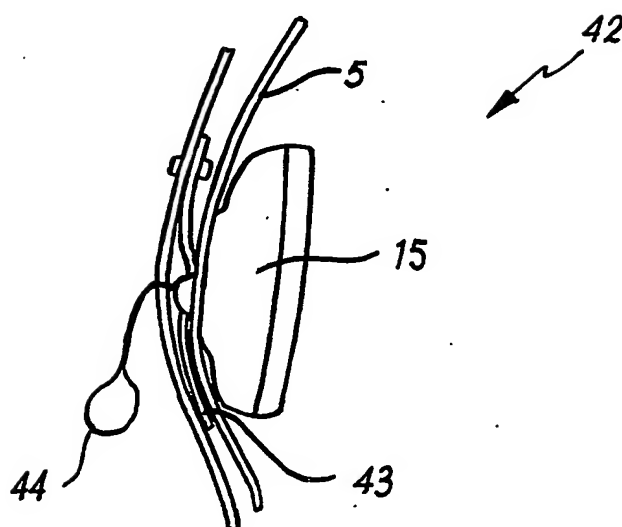
**Fig. 11**



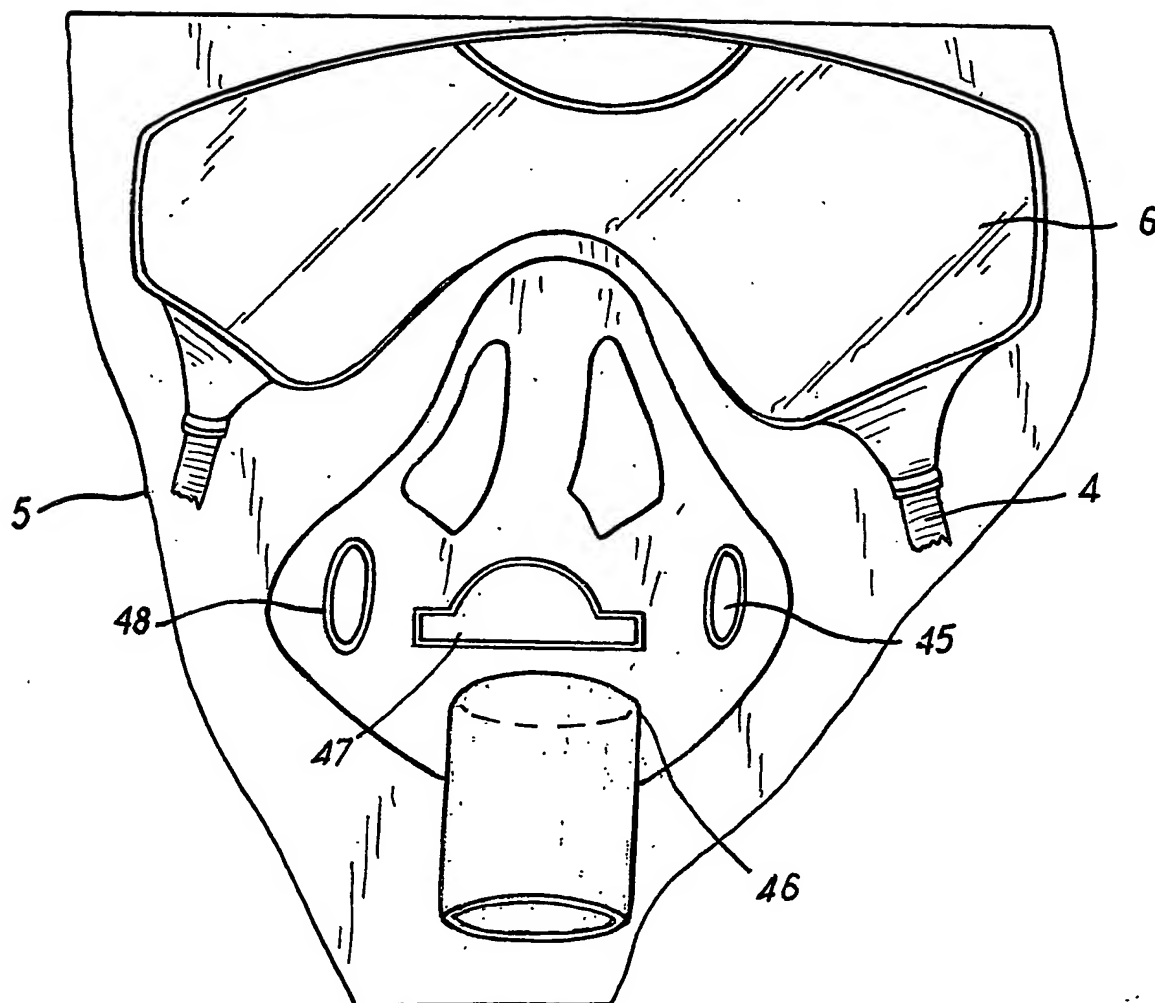
**Fig. 12**



**FIG. 13(a)**



**FIG. 13(b)**



**Fig. 14**

# INTERNATIONAL SEARCH REPORT

Intern: Application No  
PCT/GB 03/04520

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A62B7/14 A62B18/02 A62B18/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A62B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 93/14818 A (INTERTECHNIQUE SA) 5 August 1993 (1993-08-05)  the whole document	1,4-6,8, 10,12, 14,22, 26-28, 31,35,37
Y	US 4 975 980 A (ERSTENIUK STEPHEN R) 11 December 1990 (1990-12-11)  the whole document	1,4-6,8, 10,12, 14,22, 26-28, 31,35,37
A	EP 0 363 530 A (CAM LOCK UK LTD) 18 April 1990 (1990-04-18) the whole document	1-37
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

10 February 2004

Date of mailing of the international search report

18/02/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Neiller, F

# INTERNATIONAL SEARCH REPORT

Intern: Application No  
PCT/GB 03/04520

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	GB 2 379 168 A (GRIFFITHS JOSEPH ANTHONY) 5 March 2003 (2003-03-05) the whole document -----	1-37

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern

pplication No

PCT/GB 03/04520

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9314818	A	05-08-1993	FR 2686795 A1 DE 69304629 D1 DE 69304629 T2 EP 0578808 A1 WO 9314818 A1 US 5653225 A	06-08-1993 17-10-1996 03-04-1997 19-01-1994 05-08-1993 05-08-1997
US 4975980	A	11-12-1990	NONE	
EP 0363530	A	18-04-1990	GB 2203050 A EP 0363530 A1	12-10-1988 18-04-1990
GB 2379168	A	05-03-2003	NONE	

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**